WHAT IS CLAIMED IS:

1. A halftone phase shift mask blank for use in manufacturing a halftone phase shift mask which has a transmission portion for transmitting an exposure light, and a phase shifter portion for transmitting a part of the exposure light and for shifting a phase of the transmitted light by a predetermined amount on a transparent substrate, the halftone phase shift mask having an optical property that is designed so as to mutually cancel out the respective transmitted lights in the vicinity of a boundary portion of said transmission portion and the phase shifter portion to thereby keep a contrast of a boundary portion of an exposure pattern transferred onto the surface of a material to be exposed, said blank having a phase shifter film for forming said phase shifter portion on the transparent substrate,

wherein said phase shift mask is used in an exposure light wavelength range of 140 nm to 200 nm,

said phase shifter film is constituted of a film containing main elements of silicon, oxygen, and nitrogen, and contains 35 to 45% of silicon, 1 to 60% of oxygen, and 5 to 60% of nitrogen in atomic percentage, and a total amount of these elements is not smaller than 90% in a whole composition constituting said phase shifter film.

2. A halftone phase shift mask blank for use in manufacturing a halftone phase shift mask which has a transmission portion for transmitting an exposure light, and a phase shifter portion for transmitting a part of the exposure light and for shifting a phase of the transmitted light by a predetermined amount on a transparent substrate, the halftone phase shift mask having an optical property that is designed so as to mutually cancel out the respective transmitted lights in the vicinity of a boundary portion of said transmission portion and the phase shifter portion to thereby keep a contrast of

a boundary portion of an exposure pattern transferred onto the surface of a material to be exposed, said blank having a phase shifter film for forming said phase shifter portion on the transparent substrate,

wherein said phase shift mask is used in an exposure light wavelength range in the vicinity of 157 nm as a wavelength of an F_2 excimer laser,

said phase shifter film is constituted of a film containing main elements of silicon, oxygen, and nitrogen, and contains 35 to 40% of silicon, 25 to 60% of oxygen, and 5 to 35% of nitrogen in atomic percentage, and a total amount of these elements is not smaller than 90% in a whole composition constituting said phase shifter film.

3. A halftone phase shift mask blank for use in manufacturing a halftone phase shift mask which has a transmission portion for transmitting an exposure light, and a phase shifter portion for transmitting a part of the exposure light and for shifting a phase of the transmitted light by a predetermined amount on a transparent substrate, the halftone phase shift mask having an optical property that is designed so as to mutually cancel out the respective transmitted lights in the vicinity of a boundary portion of said transmission portion and the phase shifter portion to thereby keep a contrast of a boundary portion of an exposure pattern transferred onto the surface of a material to be exposed, said blank having a phase shifter film for forming said phase shifter portion on the transparent substrate,

wherein said phase shift mask is used in an exposure light wavelength range in the vicinity of a wavelength of 193 nm as an ArF excimer laser,

said phase shifter film is constituted of a film containing main elements of silicon, oxygen, and nitrogen, and contains 38 to 45% of silicon, 1 to 40% of oxygen, and 30 to 60% of nitrogen in atomic percentage, and a total amount of these elements is not smaller than 90% in a whole composition constituting said phase shifter film.

4. A halftone phase shift mask blank for use in manufacturing a halftone phase shift mask which has a transmission portion for transmitting an exposure light, and a phase shifter portion for transmitting a part of the exposure light and for shifting a phase of the transmitted light by a predetermined amount on a transparent substrate, the halftone phase shift mask having an optical property that is designed so as to mutually cancel out the respective transmitted lights in the vicinity of a boundary portion of said transmission portion and the phase shifter portion to thereby keep a contrast of a boundary portion of an exposure pattern transferred onto the surface of a material to be exposed, said blank having a phase shifter film for forming said phase shifter portion on the transparent substrate,

wherein said phase shift mask is used in an exposure light wavelength range of 140 nm to 200 nm,

said phase shifter film is constituted of a film that contains main constituting elements of silicon, oxygen, and nitrogen and that is specified by a real part n and an imaginary part k of a complex refractive index of said phase shifter film with respect to the exposure light, the real part n and the imaginary part k being not smaller than 1.7 and not greater than 0.450, respectively,

said aforementioned n, k have the following relation with an energy transmittance T of the mask, an energy reflectance R, a film thickness d of the phase shifter portion of the mask, and a refractive index n_0 of the mask substrate,

$$R = r\bar{r} \qquad r = \frac{\rho_1 + \rho_2 e^{-2\delta}}{1 + \rho_1\rho_2 e^{-2\delta}} \qquad \rho_1 = \frac{(n - ik) - 1}{(n - ik) + 1} \qquad \rho_2 = \frac{(n - ik) - n_0}{(n - ik) + n_0}$$

$$\delta = \frac{2\pi nd}{\lambda} \qquad T = t\bar{t} \cdot \frac{1}{n_0} \qquad t = \frac{\tau_1\tau_2 e^{-i\delta}}{1 + \rho_1\rho_2 e^{-2i\delta}}$$

$$\tau_1 = \frac{2}{1 + (n - ik)} \qquad \tau_2 = \frac{2n_0}{n_0 + (n - ik)}$$

where $\bar{r}$, $\bar{t}$ denote conjugated complex numbers of r, t, respectively.

5. A halftone phase shift mask blank for use in manufacturing a halftone phase shift mask which has a transmission portion for transmitting an exposure light, and a phase shifter portion for transmitting a part of the exposure light and for shifting a phase of the transmitted light by a predetermined amount on a transparent substrate, the halftone phase shift mask having an optical property that is designed so as to mutually cancel out the respective transmitted lights in the vicinity of a boundary portion of said transmission portion and the phase shifter portion to thereby keep a contrast of a boundary portion of an exposure pattern transferred onto the surface of a material to be exposed, said blank having a phase shifter film for forming said phase shifter portion on the transparent substrate,

wherein said phase shifter film is constituted of a film containing main elements of silicon, oxygen, and nitrogen, and an etching stopper film formed between said film and the transparent substrate.

6. The halftone phase shift mask blank according to claim 5 wherein said etching stopper film has a function for adjusting a transmittance.

7. The halftone phase shift mask blank according to claim 5, wherein said etching stopper film is formed by a material which is to be etched with an etchant different from that of the film containing the main elements of silicon, oxygen, and nitrogen.

8. The halftone phase shift mask blank according to claim 5, wherein said etching stopper film is formed by a material which is to be etched with the same etching medium as an etching medium of said film containing the main elements of silicon, oxygen, and nitrogen.

9. The halftone phase shift mask blank according to claim 5, wherein said phase shift mask is used in an exposure light wavelength range of 140 nm to 200 nm.

10. The halftone phase shift mask blank according to claim 5, wherein said film containing the main elements of silicon, oxygen, and nitrogen contains 30 to 45% of silicon, 1 to 60% of oxygen, and 5 to 60% of nitrogen in the atomic percentage, and the total amount of these elements is not smaller than 90% in the whole composition constituting said film.

11. A method in which the halftone phase shift mask blank according to claim 1 is manufactured,

said method comprising the steps of:

selecting sputtering gases, such as an inert gas, an oxygen gas, and a nitrogen gas to sputter said film containing the main elements of silicon, oxygen, and nitrogen in a reactive sputtering process; and

adjusting a ratio of oxygen in said sputtering gas to a range between 0.2 and 30%.

12. A halftone phase shift mask which has a mask pattern constituted of a light transmission portion and a phase shifter portion and obtained by subjecting the phase shifter film in the halftone phase shift mask blank according to claim 1 to a patterning treatment to selectively remove the phase shifter film and to thereby obtain a predetermined pattern.

13. A pattern transfer method in which the halftone phase shift mask according to claim 12 is used to transfer the pattern.

14. A halftone phase shift mask blank for use in manufacturing a halftone phase shift mask which has a transmission portion for transmitting an exposure light, and a phase shifter portion for transmitting a part of the exposure light and for shifting a phase of the transmitted light by a predetermined amount on a transparent substrate, the halftone phase shift mask having an optical property that is designed so as to mutually cancel out the respective transmitted lights in the vicinity of a boundary portion of said transmission portion and the phase shifter portion to thereby keep a contrast of

a boundary portion of an exposure pattern transferred onto the surface of a material to be exposed, said blank having a phase shifter film for forming said phase shifter portion on the transparent substrate,

wherein said phase shifter film is constituted of first and second layers which are successively deposited on the transparent substrate in order and which are to be continuously etched by the same etching medium;

the second layer being formed by a material unsuitable for detecting an end point of etching in relation to the transparent substrate while the first layer is formed by a material suitable for detecting the end point of etching in relation to the transparent substrate.

15. A halftone phase shift mask blank as claimed in claim 14, wherein a difference in refractive index between the second layer and the transparent substrate is not greater than 0.5 at an end point detection light while a difference in refractive index between the first layer and the transparent substrate is greater at the end point detection light than the above-mentioned difference between the second layer and the transparent substrate.

16. A halftone phase shift mask blank as claimed in claim 14, wherein the phase shifter film has a structure of first and second layers which are successively deposited on the transparent substrate in order;

the first layer being mainly operable to adjust a transmittance while the second layer is mainly operable to adjust a phase.

17. A halftone phase shift mask blank as claimed in claim 14, wherein the first layer is formed by a material selected from a group consisting of Si and MSix (M: at least one element selected from a group consisting of Mo, Ta, W, Cr, Zr, Hf) while the second layer is formed by a material that comprises SiOx, SiOxNy, or M (M: at least one element selected from a group consisting of Mo, Ta, W, Cr, Zr, Hf) together with SiOx, SiOxNy and that is specified by a ratio of M/(Si + M) which is not greater than 0.1.

18. A halftone phase shift mask which has a mask pattern constituted of a light transmission portion and a phase shifter portion and obtained by subjecting the phase shifter film in the halftone phase shift mask blank according to claim 14 to a patterning treatment to selectively remove the phase shifter film and to thereby obtain a predetermined pattern.

19. A pattern transfer method in which the halftone phase shift mask according to claim 14 is used to transfer the pattern.